PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification [5]: H01T 1/12, 1/14, F21V 25/10, H02H 7/04 | A1

(11) International Publication Number: **WO 94/21014**

(43) International Publication Date: 15 September 1994 (15.09.94)

(21) International Application Number: PCT/AU94/00100

(22) International Filing Date: 4 March 1994 (04.03.94)

(30) Priority Data:
PL 7658 5 March 1993 (05.03.93) AU

(71) Applicant *(for all designated States except US)*: NEOLITE NEON COMPANY PTY. LIMITED [AU/AU]; 225 Queen Street, Beaconsfield, NSW 2015 (AU).

(72) Inventors; and

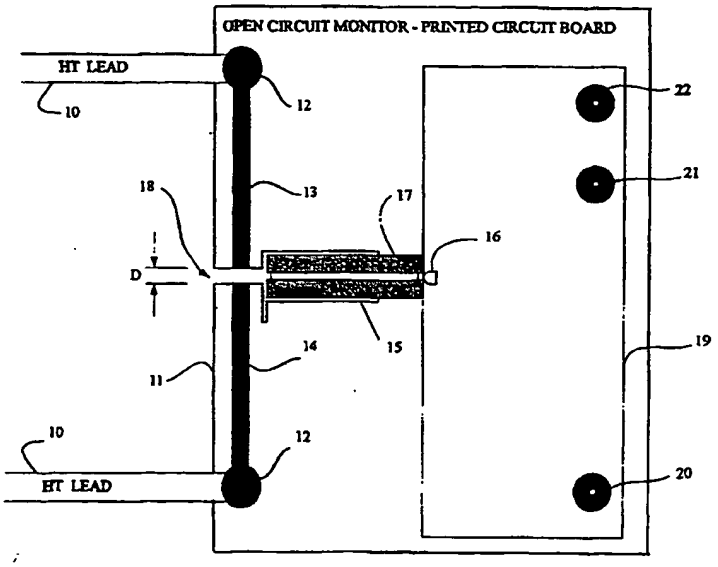
(75) Inventors/Applicants *(for US only)*: FORSTER, Keith, Arnold [AU/AU]; 32 Alice Street, Turramurra, NSW 2074 (AU). FORSTER, Eric, John [AU/AU]; 11A Madeleine Court, Mt. Colah, NSW 2079 (AU).

(74) Agent: SPRUSON & FERGUSON; GPO Box 3898, Sydney, NSW 2001 (AU).

(81) Designated States: AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KG, KP, KR, KZ, LK, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: ARC DETECTION IN NEON LIGHTING SYSTEMS



(57) Abstract

A protection arrangement for use with HT transformers in neon lighting systems is disclosed. Besides the main HT leads that feed the neon display, a set of auxiliary HT leads (10) from the transformer connect to PCB (11) which has HT tracks (13, 14) separated by a slot (18), which provides a measured air gap which determines the arc-over voltage. An optical fibre (15) is arranged to conduct light from an arcing of the air gap under fault conditions, to a phototransistor (16). The phototransistor is arranged to trigger an isolation circuit (19) to disconnect AC mains from the transformer.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AT	Austria	GB	United Kingdom	MR	Mauritania
AU	Australia	GE	Georgia	MW	Malawi
BB	Barbados	GN	Guinea	NE	Niger
BE	Belgium	GR	Greece	NL	Netherlands
BF	Burkina Faso	HU	Hungary	NO	Norway
BG	Bulgaria	IE	Ireland	NZ	New Zealand
BJ	Benin	IT	Italy	PL	Poland
BR	Brazil	JP	Japan	PT	Portugal
BY	Belarus	KE	Kenya	RO	Romania
CA	Canada	KG	Kyrgystan	RU	Russian Federation
CF	Central African Republic	KP	Democratic People's Republic of Korea	SD	Sudan
CG	Congo			SE	Sweden
CH	Switzerland	KR	Republic of Korea	SI	Slovenia
CI	Côte d'Ivoire	KZ	Kazakhstan	SK	Slovakia
CM	Cameroon	LI	Liechtenstein	SN	Senegal
CN	China	LK	Sri Lanka	TD	Chad
CS	Czechoslovakia	LU	Luxembourg	TG	Togo
CZ	Czech Republic	LV	Latvia	TJ	Tajikistan
DE	Germany	MC	Monaco	TT	Trinidad and Tobago
DK	Denmark	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	US	United States of America
FI	Finland	ML	Mali	UZ	Uzbekistan
FR	France	MN	Mongolia	VN	Viet Nam
GA	Gabon				

ARC DETECTION IN NEON LIGHTING SYSTEMS

Field of the Invention

The present invention relates to high-voltage systems, and in particular, to the protection of such systems from electrical arcing and flashover of the high tension electrical supplies used therein.

Background Art

Neon-type lighting systems are well known in the art and there have been previous numerous attempts to provide protection equipment to protect electrical transformers used therein and the like from destruction due to minor or more substantial failure of the high tension supply or the gas filled tubing used therewith.

International Patent Application No. PCT/AU92/00484 (WO 93/09584), filed by the present applicant, identifies a number of arrangements which protect against failure of the high tension transformer due to undercurrent conditions caused by electrical open circuits.

However, because of the nature of such systems, and particularly when electrical open circuits occur, the danger of electrical arc-over (or flash-over) is significant. Arc-over can occur through termination failure of the HT leads interconnecting the transformer with the neon display. An electrical open-circuit of the HT winding can cause a substantial increase in the HT voltage which destory the HT winding of the transformer. While specifically applicable to neon-type lighting systems, the same problem is relevant to all high-voltage systems.

Summary of the Invention

It is an object of the present invention to substantially overcome, or ameliorate, some or all of the abovementioned problems.

In accordance with one aspect of the present invention there is disclosed a protection device for use with a high-tension transformer, said device comprising:

input means for receiving an AC mains supply;

output means for conveying said AC mains supply to a primary winding of said transformer;

a pair of terminal means spaced apart by a predetermined distance and to which a secondary high-tension winding of said transformer is connectable;

a light detection means associated with said terminal means and arranged to detect an electrical arc therebetween; and

a switching means arranged to isolate said AC mains supply from said output means when an arc is detected by said detection means.

Preferably, the protection device is formed on a printed circuit board (PCB) to which a pair of high-tension (HT) leads extending from the transformer connect. Most preferably, the connection points on the PCB for the HT leads are spaced apart, and extending between the connection points are PCB tracks which approach each other to be spaced apart by the predetermined distance. In this manner, the electrical arcing voltage can be closely controlled by separation between the PCB tracks.

Brief Description of the Drawings

A number of preferred embodiments of the present invention will now be described with reference to the drawings in which:

Fig. 1 is a schematic block diagram representation of a neon lighting system which incorporates a preferred embodiment;

Fig. 2 is a schematic representation of the configuration of the open circuit monitor of the embodiment of Fig. 1;

Fig. 3 is a schematic circuit diagram of the open circuit monitor of Figs. 1 and 2; and

Fig. 4 is a representation similar to Fig. 2 but of another embodiment.

Best and Other Modes for Performing the Invention

As shown in Fig. 1, a neon lighting system 1 incorporates a mains supply 2 which is supplied to an open circuit monitor 3 which can be configured with an electronic circuit in accordance with the disclosure of International Patent Application No. PCT/AU92/00484. Extending from the open circuit monitor 3 is a transformer supply connection 4 to a high tension (HT) transformer 6. The open circuit monitor 3 is configured with an isolation switch (not illustrated in Fig. 1), usually a triac, which is configured to isolate the mains supply 2 from the input supply connection 4 when a fault is detected. An earth connection 5 connects to a casing of the transformer 6 to ensure electrical safety and comply with statutory requirements. The HT transformer 6 includes two HT terminals 8 from which two HT leads 7 extend to supply a neon lighting display 9. An auxiliary set of HT leads 10 extends from the terminals 8 and returns to the open circuit monitor 3.

Referring now to Fig. 2, the HT leads 10 connect to pad contacts 12 arranged on a printed circuit board (PCB) 11 of the open circuit monitor 3. The pad contacts 12 can comprise either soldered connections or bolted connections.

The pad contacts 12 are spaced apart a significant distance substantially in excess of the breakdown voltage of the insulation of the HT leads 10. Extending from the pad contacts 12 are PCB tracks 13 and 14 which extend towards each other to be spaced apart by a slot 18 arranged in the substrate of PCB 11 which provides an air gap of a predetermined distance D. The distance D can be determined from the selected minimum arc-over voltage desired in the lighting system 1.

It is known that electrical systems in air break down where the electric field exceeds approximately 30,000 volts per centimeter. As most neon lighting systems use high tension supplies between 3,000 volts and 15,000 volts, the distance D can be varied to a distance for example, 20% in excess of the nominal-loaded voltage of the HT winding. For example, if the HT winding is rated at 10,000 volts under normal load conditions, the distance D can be set for electrical breakdown at say, 12,000 volts. In such a case the distance D would be 4mm. Typical distances for the distance D would be between .02 and 10mm in most high voltage applications.

Arranged on the printed circuit board 11 in the slot 18 at a position adjacent to the closest point of separation of the PCB tracks 13 and 14, is an optical sensor 15, such as an optical fibre. The optical fibre sensor 15 is positioned such that light created in an electrical arc-over between the PCB tracks 13 and 14 is conveyed along the optical fibre 15 to a photo transistor 16 arranged at a safe, electrically isolated distance from the HT tracks 13 and 14. The photo transistor 16 is configured as part of an electrical circuit 19 of the open circuit monitor 3 to which the mains supply 2 and transformer supply 4 connect via pad contacts 20, 21 and 22.

The optical fibre sensor 15 is advantageous as it provides a high degree of electrical isolation between the circuit 19 of the open circuit monitor 3 arranged on the PCB 11, and the high voltage PCB tracks 13,14. The optical fibre sensor 15 preferably has an opaque outer sheath 17.

Furthermore, the physical separation between the high voltage PCB tracks 13,14 and the circuit 19 permits the enclosure of the tracks 13,14 by an opaque insulator (not illustrated), such as a plastic casing or box, which prevents ambient light enabling the phototransistor 16.

Fig. 3 shows the electronic circuit 19 of the open circuit monitor 3 and is similar to that disclosed of the aforementioned International

Patent Application. The phototransistor 16 is arranged to trigger the circuit 19 to cause a triac 23 to open thereby isolating the Active Out pad 22 from the Active In pad 21 when an arc over occurs in the air gap at the slot 18.

In the embodiment of Fig. 4, the open-circuit monitor 3 is configured to adjust the size of the air gap and therefore is suitable for a variety of applications. In this embodiment, the optical fibre 15, phototransistor 16 and pad contacts 12 are configured in the same manner. The slot 18 is however much wider, and arranged at the periphery of the HT track 13 adjacent the slot 18 is a metal contact block 30, electrically connected to the track 13.

Similarly, the track 14 has electrically connected to it a threaded block 31 through which a conductive screw or bolt 32 is arranged. Configured at the end of the bolt 32 adjacent the slot 18 is a cylindrical metal block 33. With this configuration, the flash-over voltage is set by the separation of the blocks 30 and 33. As the block 33 is movable through adjustment of the bolt 32, the flash-over voltage can be preset during manufacture or during installation. Once set, the bolt 32 can be secured using a few drops of adhesive, such as epoxy resin to fix the bolt 32 to the threaded block 31.

The foregoing describes only a number of embodiments of the present invention and modifications, obvious to those skilled in the art can be made thereto without departing from the scope of the present invention.

Industrial Applicability

The present disclosure is applicable to high voltage systems and, in particular, neon-lighting systems.

CLAIMS:

1. A protection device for use with a high-tension transformer, said device comprising:

input means for receiving an AC mains supply;

output means for conveying said AC mains supply to a primary winding of said transformer;

a pair of terminal means spaced apart by a predetermined distance and to which a secondary high-tension winding of said transformer is connectable;

a light detection means associated with said terminal means and arranged to detect an electrical arc therebetween; and

a switching means arranged to isolate said AC mains supply from said output means when an arc is detected by said detection means.

2. A protection device as claimed in claim 1, wherein said pair of terminal means comprises conductor tracks on a printed circuit board.

3. A protection device as claimed in claim 2, wherein at least part of said predetermined distance is formed by a slot in said circuit board between said conductor tracks.

4. A protection device as claimed in claim 1, wherein said pair of terminals comprises a pair of electrical connector blocks.

5. A protection device as claimed in claim 4, wherein one of said blocks is movable towards and away from the other said block such that the electrical flash-over distance therebetween can be varied.

6. A protection device as claimed in claim 5, wherein said one block is mounted for threaded movement.

7. A protection device as claimed in claim 1, wherein light detection means comprises an optical fibre having a first end positioned adjacent said pair of terminal means and configured to conduct light generated by said electrical arc.

8. A protection device as claimed in claim 7, wherein said light detection means further comprises a light sensitive semiconductor device arranged at a second end of said fibre, said semiconductor device acting upon said switching means to isolate said AC mains supply.

9. A protection device as claimed in claim 1, wherein said switching means is further configured to detect an open circuit in said secondary high tension winding and to isolate said AC mains supply in response thereto.

10. A gas-filled lighting system comprising;
a gas filled lighting display;
a high tension transformer for supplying said display; and
an open circuit monitor comprising a protection device as claimed in claim 1.

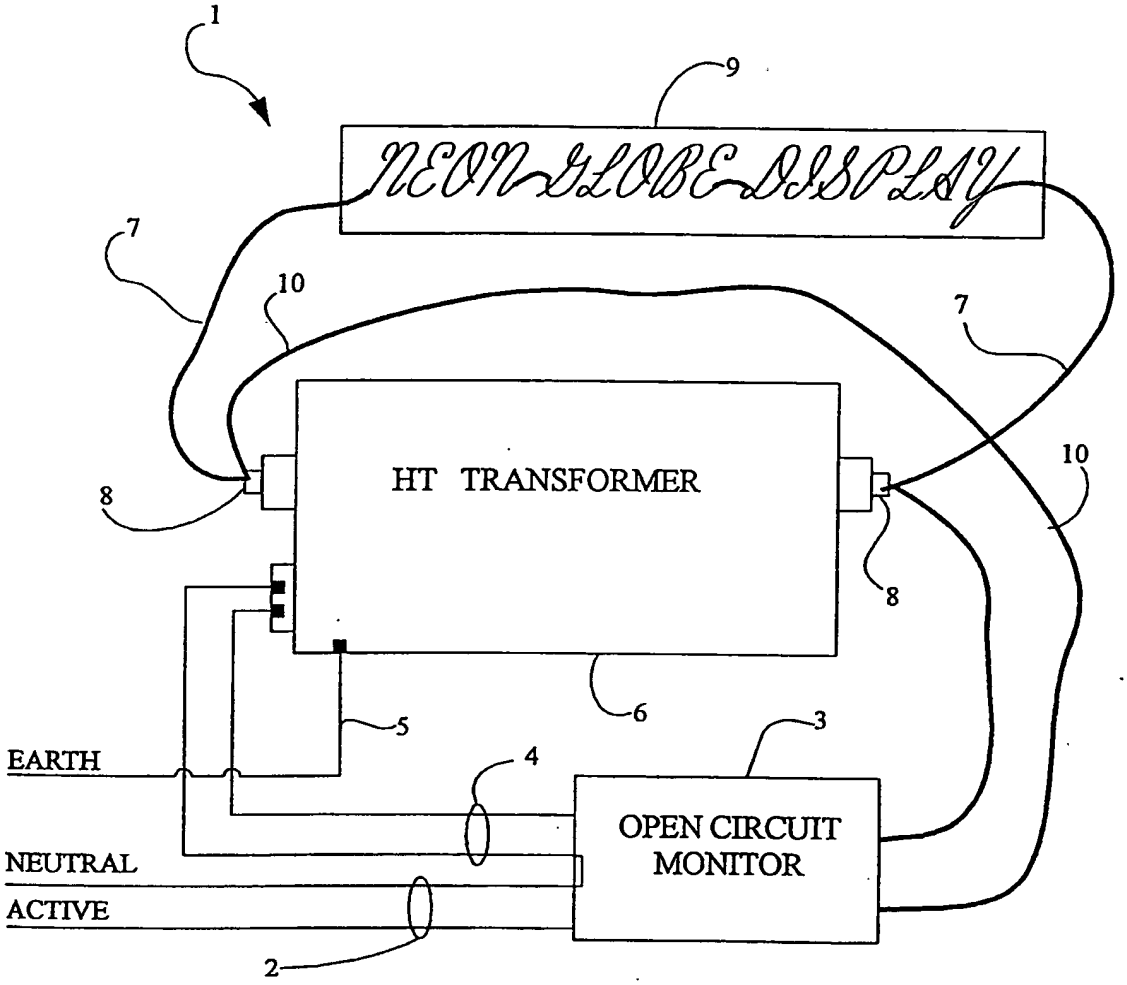

1
9
NEON GLOBE DISPLAY
7
10
7
10
HT TRANSFORMER
8
8
6
5
3
4
EARTH
OPEN CIRCUIT
MONITOR
NEUTRAL
ACTIVE
2

FIG. 1

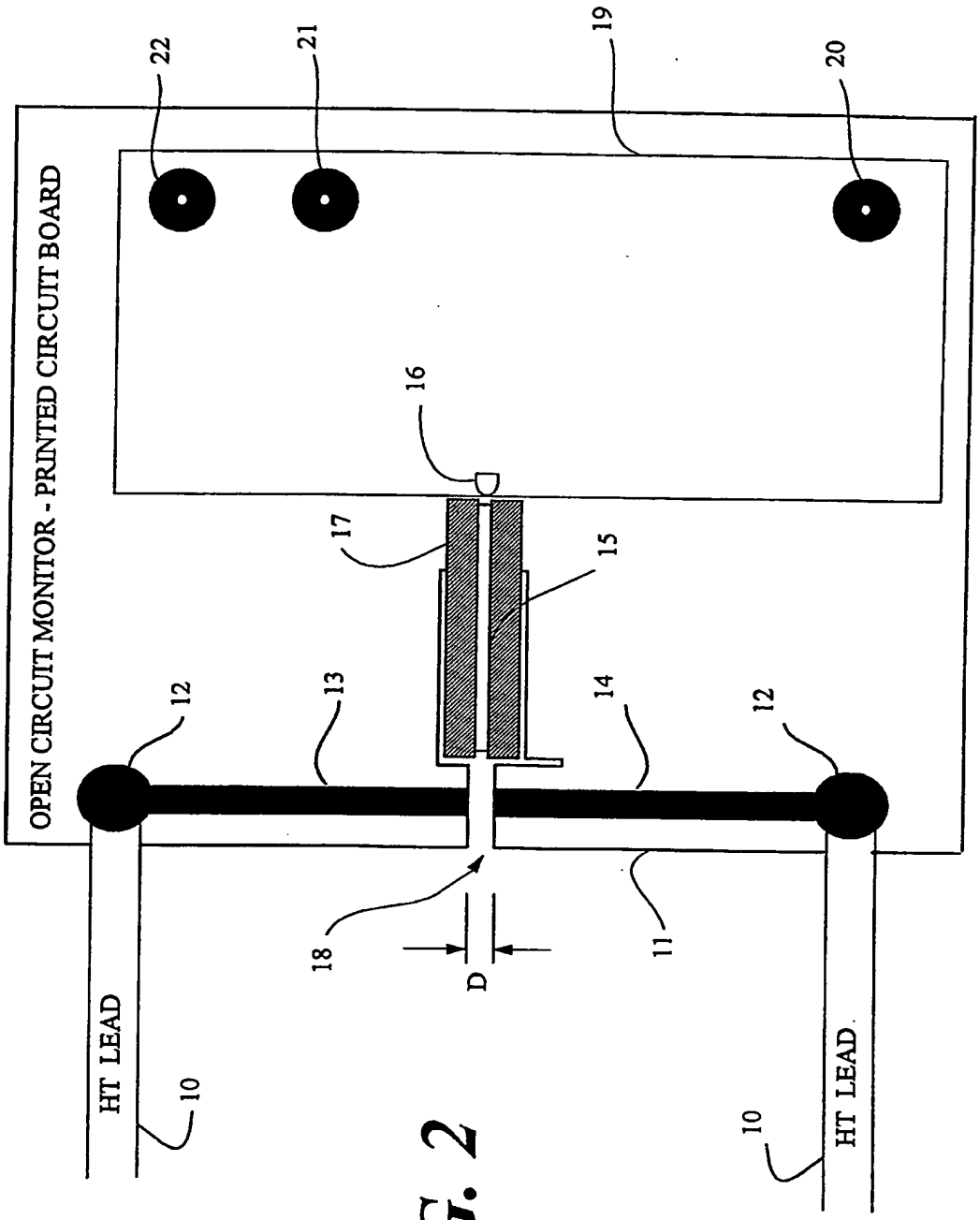

OPEN CIRCUIT MONITOR - PRINTED CIRCUIT BOARD
22
21
19
20
16
17
15
12
13
14
12
18
D
11
HT LEAD
10
10
HT LEAD

FIG. 2

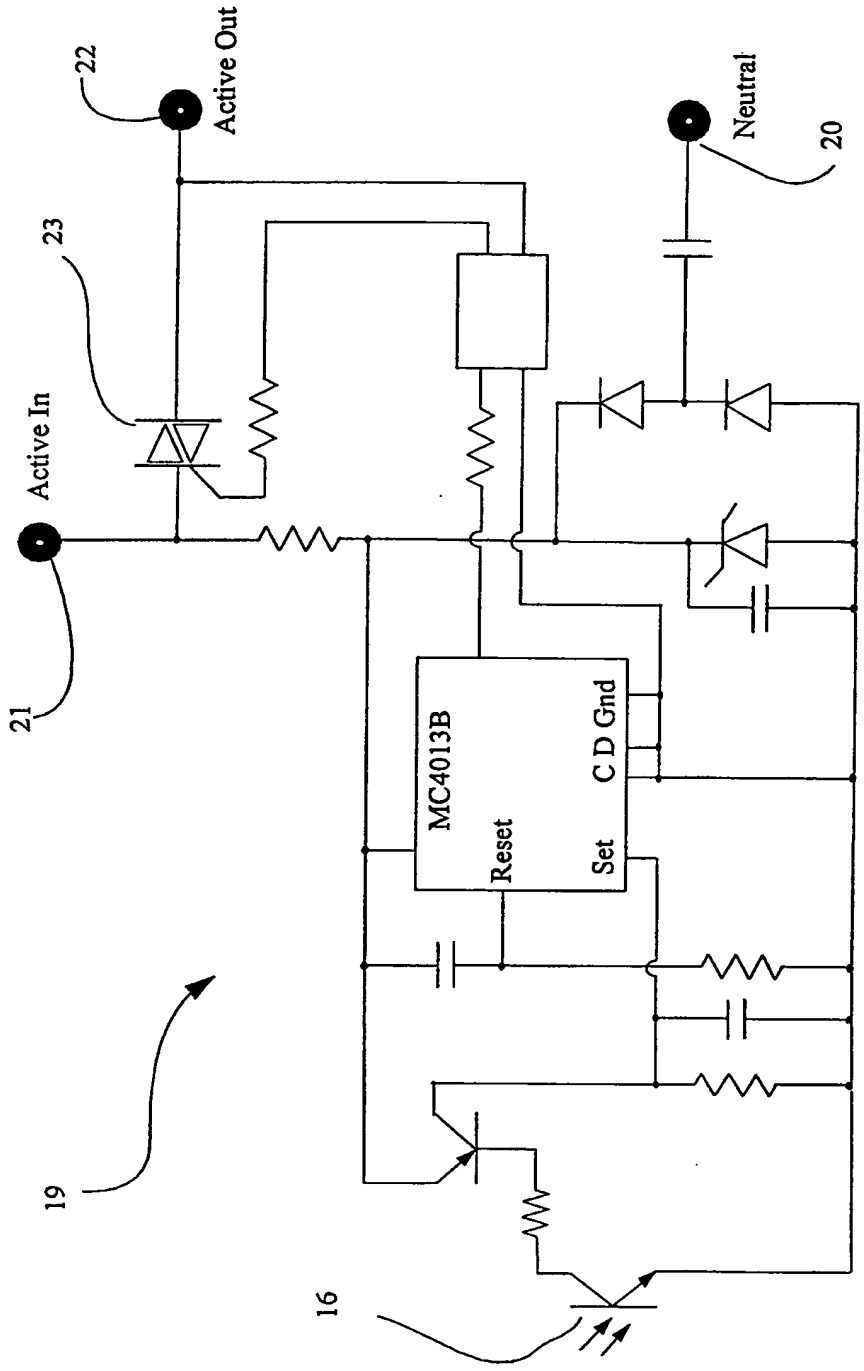

22
Active Out
Neutral
20
23
Active In
21
MC4013B
Reset
Set
C D Gnd
19
16

FIG. 3

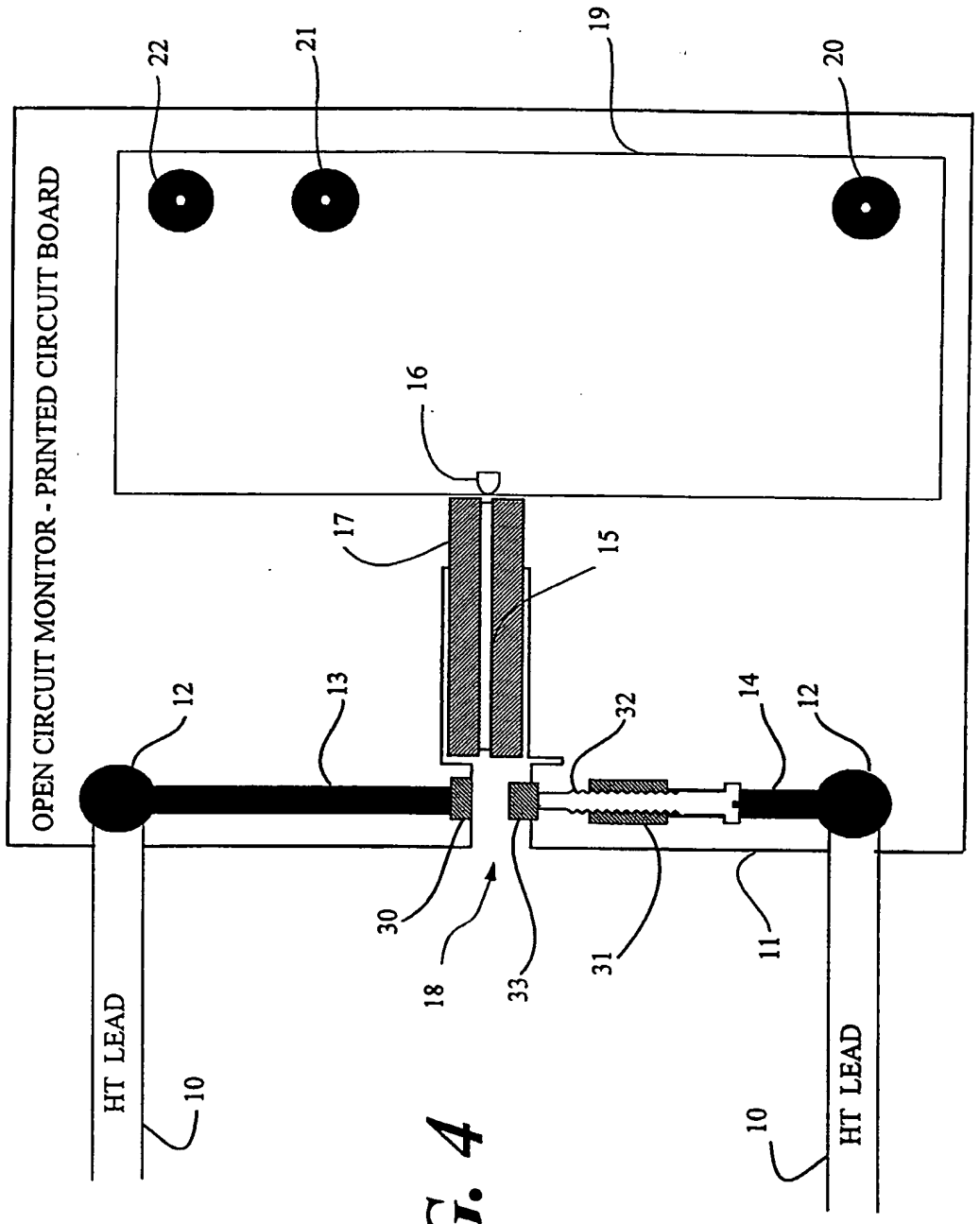

OPEN CIRCUIT MONITOR - PRINTED CIRCUIT BOARD
22
21
19
20
16
17
15
12
13
32
14
12
30
18
33
31
11
HT LEAD
10
10
HT LEAD

FIG. 4

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 94/00100

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl.[5] H01T 1/12, 1/14, F21V 25/10, H02H 7/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC H01T 1/12, 1/14, F21V 25/10, 25/00, H02H 3/20, 7/04

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base, and where practicable, search terms used)
DERWENT, CAPRI, INPADOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
Y	FR,A, 2397728 (SPRECHER & SCHUH S.A.) 16 March 1979 (16.03.79) Page 2 line 16 - page 3 line 35, Fig. 1	1,4,7
Y	US,A, 3450946 (CAMACHO) 17 June 1969 (17.06.69) Abstract, Fig. 1	1,4,7
A	GB,A, 2211684 (OBO BETTERMANN OHG) 5 July 1989 (05.07.89) Abstract, Fig. 1	
A	US,A, 4968897 (MURRAY) 6 November 1990 (06.11.90) Abstract, Fig. 3	

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
14 June 1994 (14.06.94)	22 June 1994 (22.06.94)
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. 06 2853929	Authorized officer R. CHIA Telephone No. (06) 2832195

INTERNATIONAL SEARCH REPORT
Information on patent family membe

International application No.
PCT/AU 94/00100

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
FR	2397728	AT	3448/78	CH	615784		
GB	2211684	AT	1566/88	BE	1001261	CH	677422
		DE	3736053	ES	2009632	FR	2622370
		IT	1227256	NL	8802601	SE	8802752
							END OF ANNEX